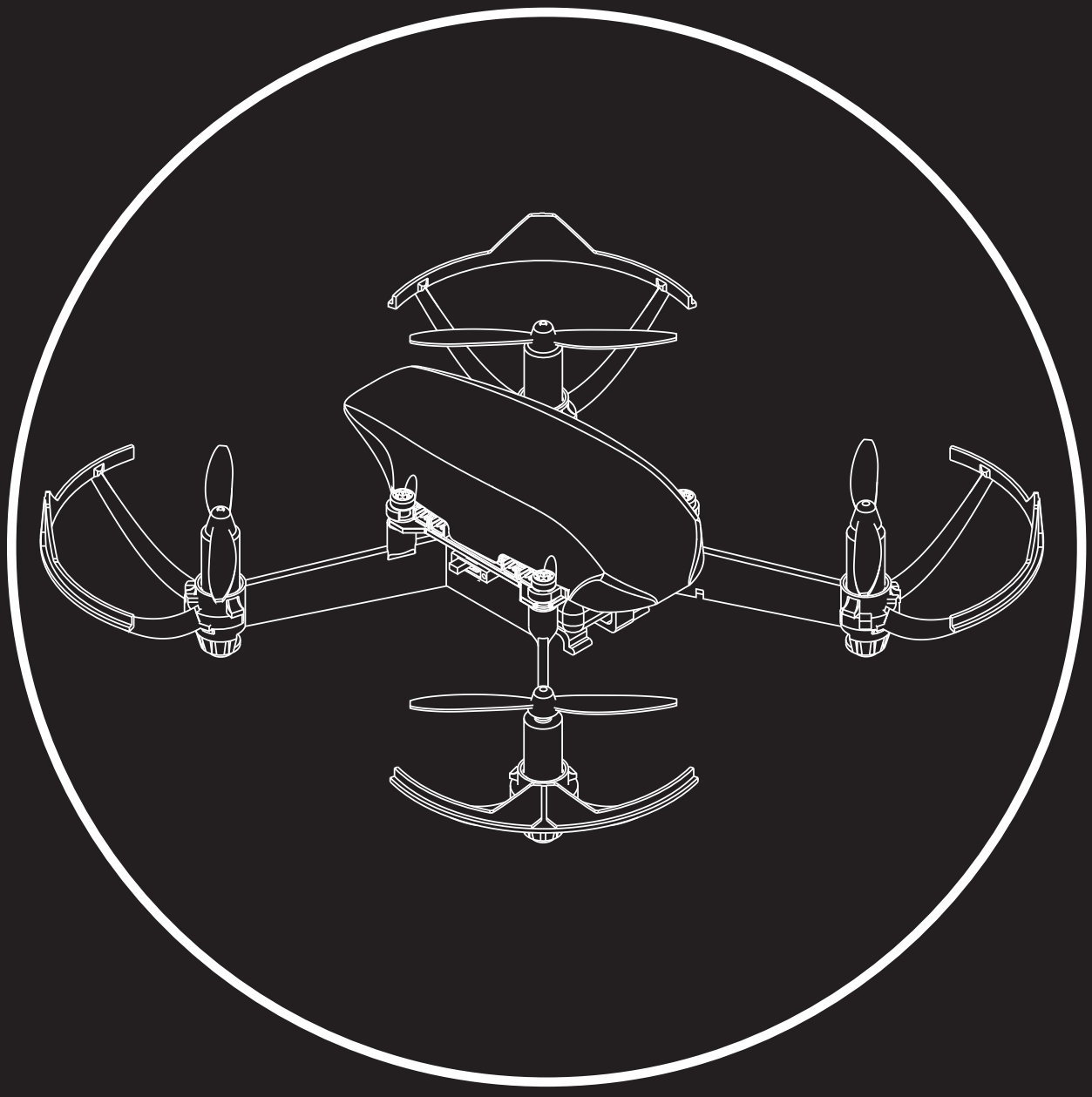
DRONA™ AVIATION

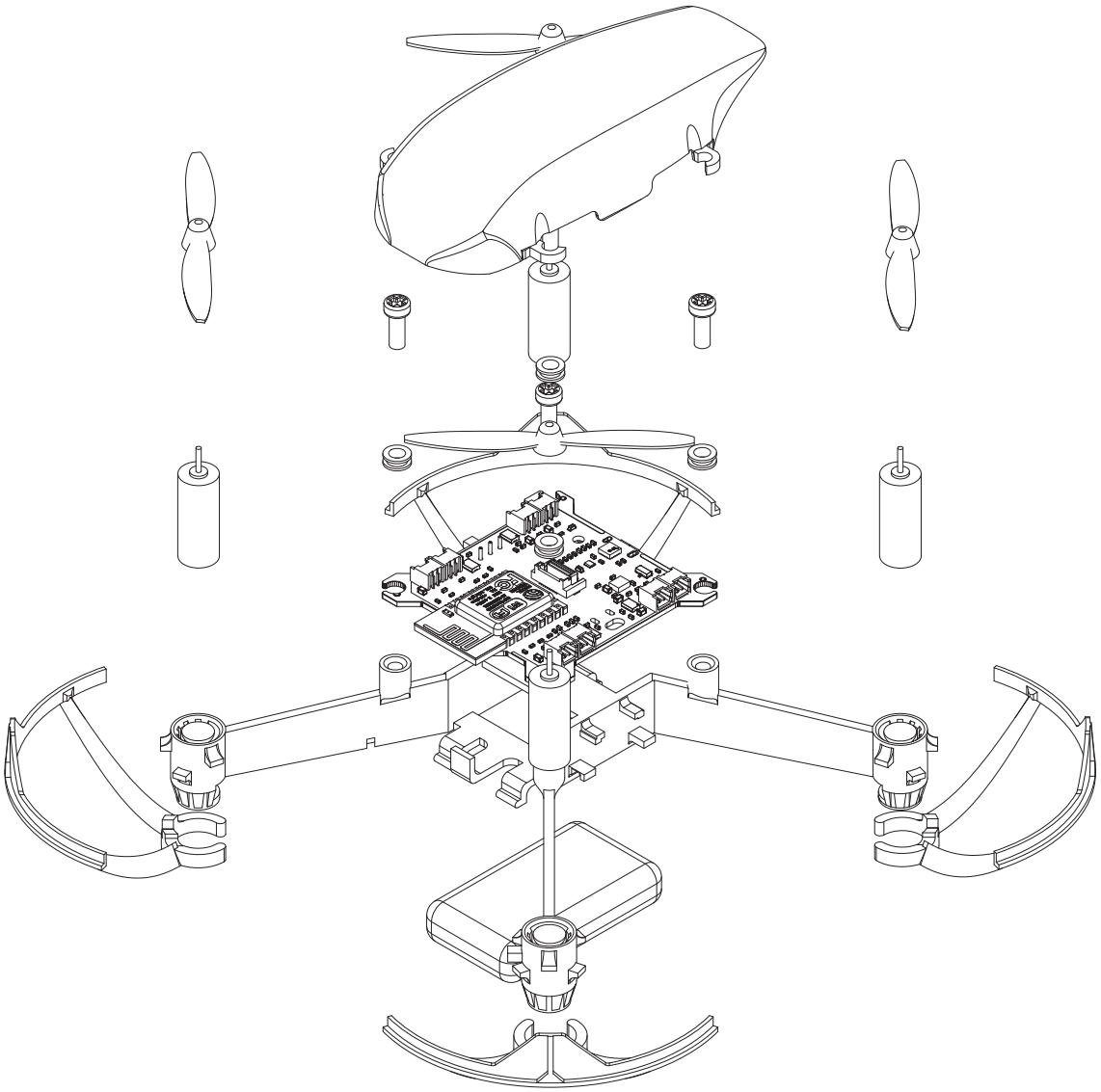
pluto X



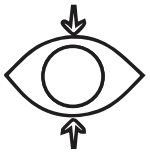
PlutoX User Manual

V1.1

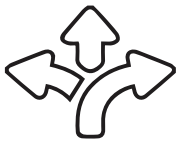
PlutoX
User Manual



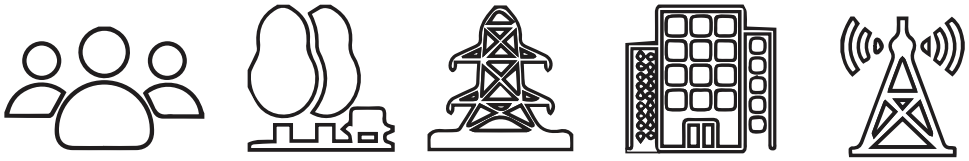
Fly in open areas



Maintain Line of Sight

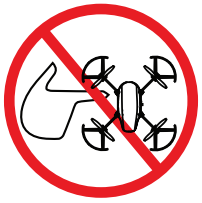


Flying range - 60m



Avoid flying over or near obstacles, crowd, high voltage power lines trees or bodies of water and near strong electromagnetic sources such as power lines and base stations.

Don't use PlutoX in adverse weather conditions such as rain, snow, storm etc. and in high wind



STAY AWAY FROM ROTATING PROPELLERS

DON'T FLY IN NO-FLY ZONE

Battery Safety

CAUTION: All instructions and warnings must be followed exactly. Mishandling of Li-Po batteries can result in a fire, personal injury and/or property damage.

LI-PO BATTERIES: Failure to charge the battery with a compatible charger may cause a fire resulting in personal injury and/or property damage.

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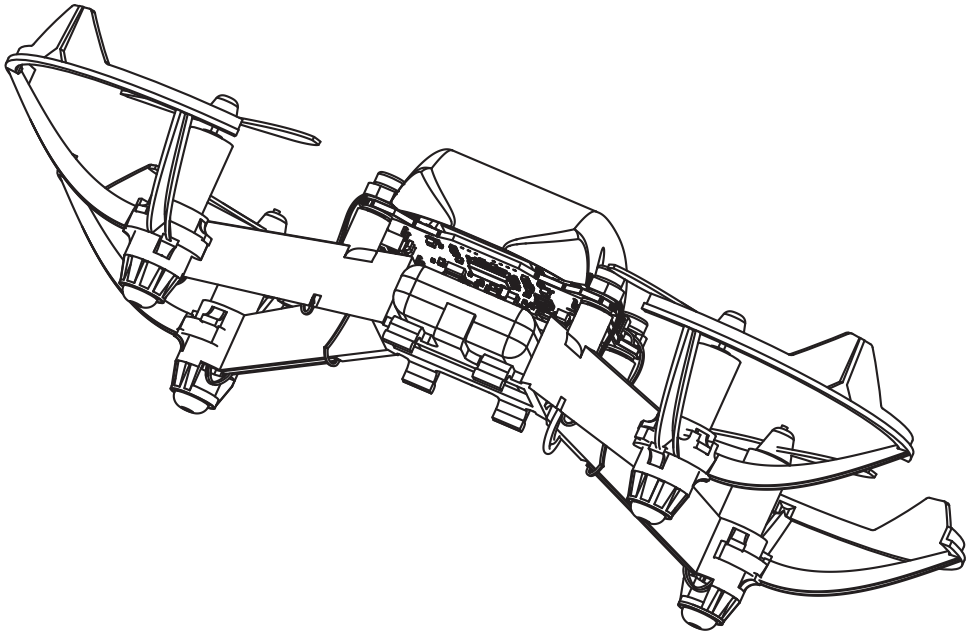
Introduction

Hi!
We know you must be excited to fly your PlutoX. Before you start tinkering on your own, we strongly recommend that you follow the quick start guide so that you have a seamless experience with your first flight. This manual also helps you disassemble / assemble your PlutoX and do more with your drone. Happy tinkering!!

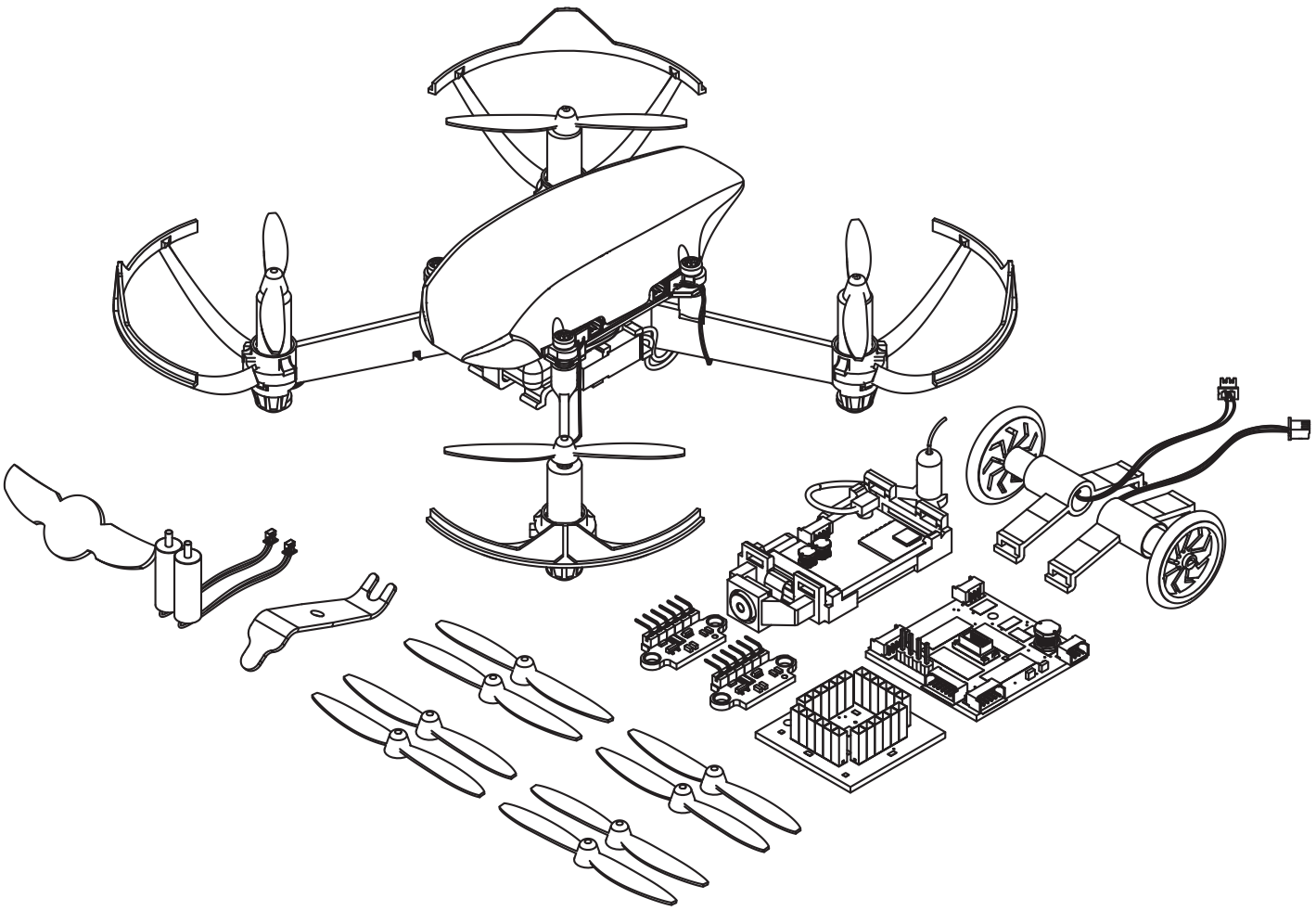


Note: Please read and understand this manual completely. Drona Aviation products are to be used by ages 14 and over. The instruction manual, warranties and other associated documentation is subject to change without notice. Drona Aviation assumes no responsibility for inadvertent errors in this manual.

Box Contents

PlutoX is a drone kit meant for accelerated development from idea to prototype. Currently, two different kits are available: Starter Kit & Tinkerer Kit.

KIT	STARTER	TINKERER
Fully assembled PlutoX	✓	✓
1 set of Extra propellers	✓	✓
Prop tool	✓	✓
2 spare motor	✓	✓
X-breakout accessory	✓	✓
Wi-Fi camera	✓	✓
Rookie Pilot badge	✓	✓
Pair of hybrid motors	✗	✓
X-Ranging accessory	✗	✓

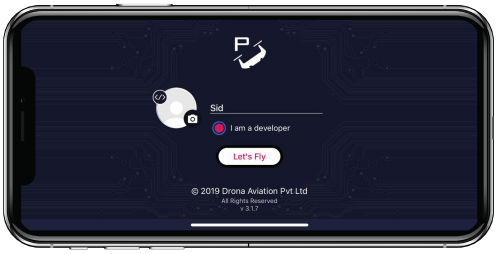


Quick Flight

Step 1 : Install “Pluto Controller” App Controller

GET IT ON Google Play

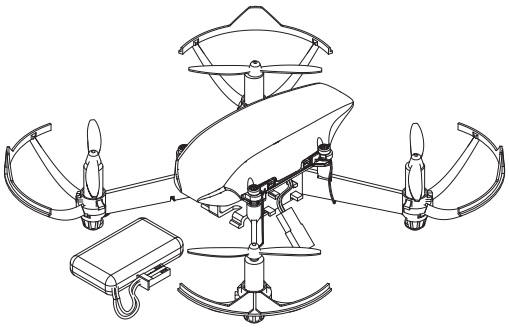
Download on the App Store



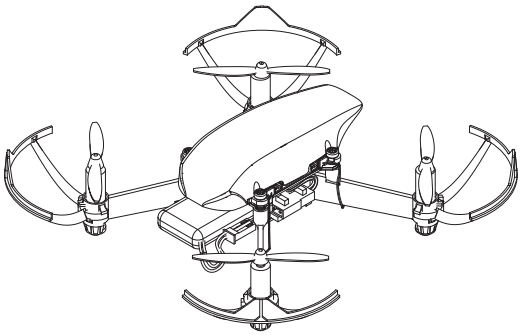
Tip: Select ‘I am a Developer’ while setting up profile to enable user based programming. Visit the section ‘Developer options’ for more details

Step 2 : Plug in Battery

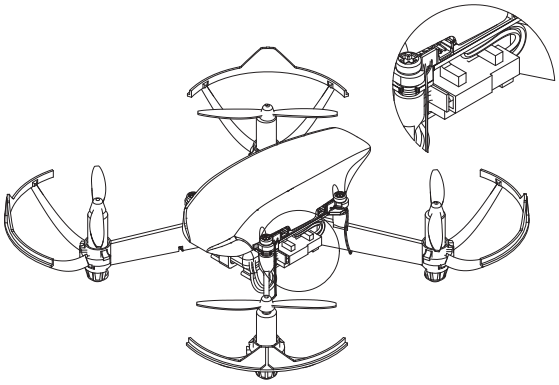
Insert the battery from the front of the drone as shown in the figure.



Carefully route the battery connector and connect to the board connector.



Use the connector holder to secure the connector to the frame.

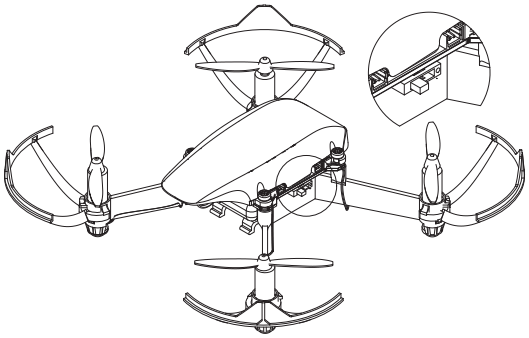


CAUTION

Note: he battery provided in the kit is charged to 20%. It is recommended that you charge the battery before your first flight.
We also strongly recommend that you do your first flight without camera

Step 3 : Turn on the drone

Switch on PlutoX using the slide switch on the right side of the drone.



Step 4 : Connect to your drone

A. PlutoX generates its own wifi hotspot. Using wifi settings on your smart-phone,you will discover PlutoX_xxxx wifi hotspot.

B. Connect to the hotspot using the password provided in the box.

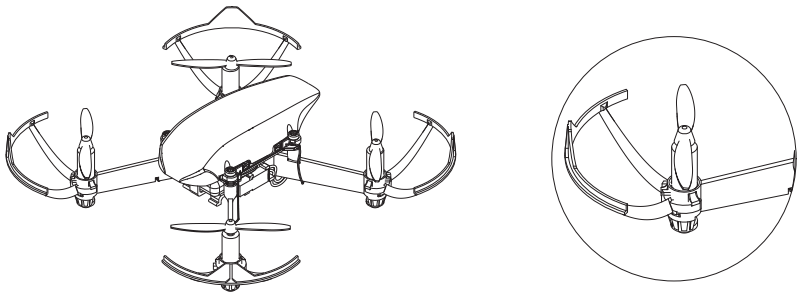
C. Open the Pluto Controller app.

D. Click on the CONNECT button.

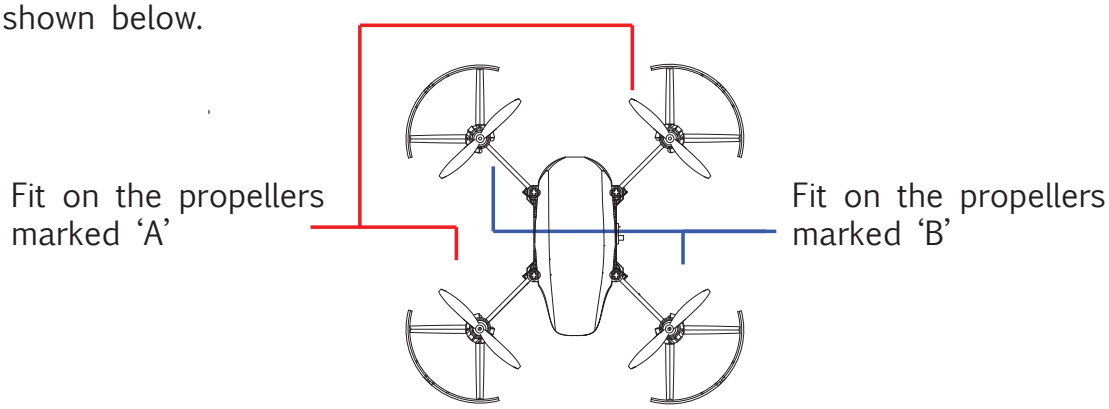
Step 5: Preflight Checklist

Please check the following:

A. Prop-guards are attached securely.

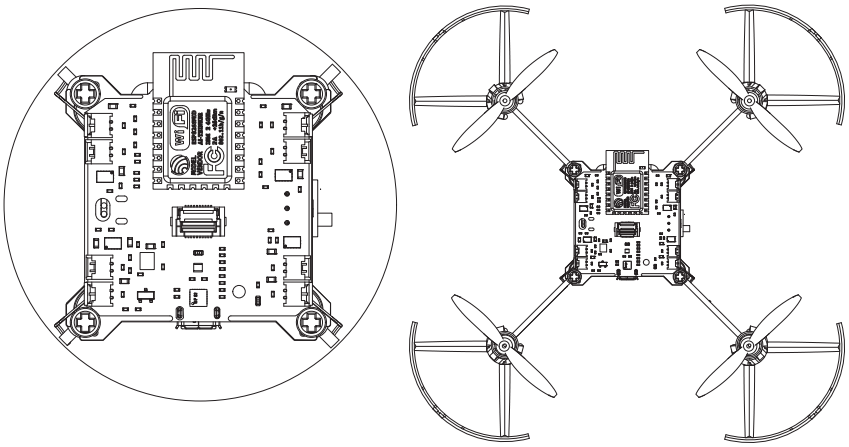


B. There are two sets of propellers A & B. You can find the markings near the hub of the propeller. Make sure that the propellers are mounted as shown below.



C. Battery voltage before arming should be above 3.8V. This ensures good flight

D. Please ensure that the motors are connected in the right ports: M5, M6, M7,

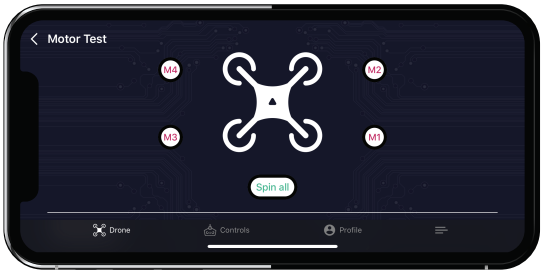


E. Perform motor test using “Pluto Controller”.

1. Go to Menu > Drone Settings > Motor test

2. Tap on “Spin all”

3. Verify if all propellers are rotating. If not, please verify step D



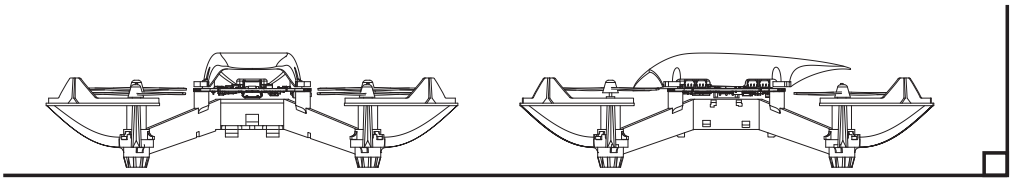
F. Perform accelerometer calibration

1. This calibration accounts for misalignment of the flight controller and frame.

2. Place PlutoX on a perfectly level surface.

3. In the app, go to: Menu > Drone Settings > Acc. Calibration

4. This will reduce the drift, but not eliminate it completely. For eliminating the drift you will have to trim the drone(please refer to chapter: TRIM).



Note: During control, the flight controller assumes that it is perfectly aligned to the ground. This results in drifts. To account for misalignment, we need to calibrate the accelerometer.

G. Perform Magnetometer calibration

1. This calibration accounts for stray magnetic fields. This is essential to achieve good yaw stability.

2. In the app, go to: Menu > Drone Settings > Mag. Calibration

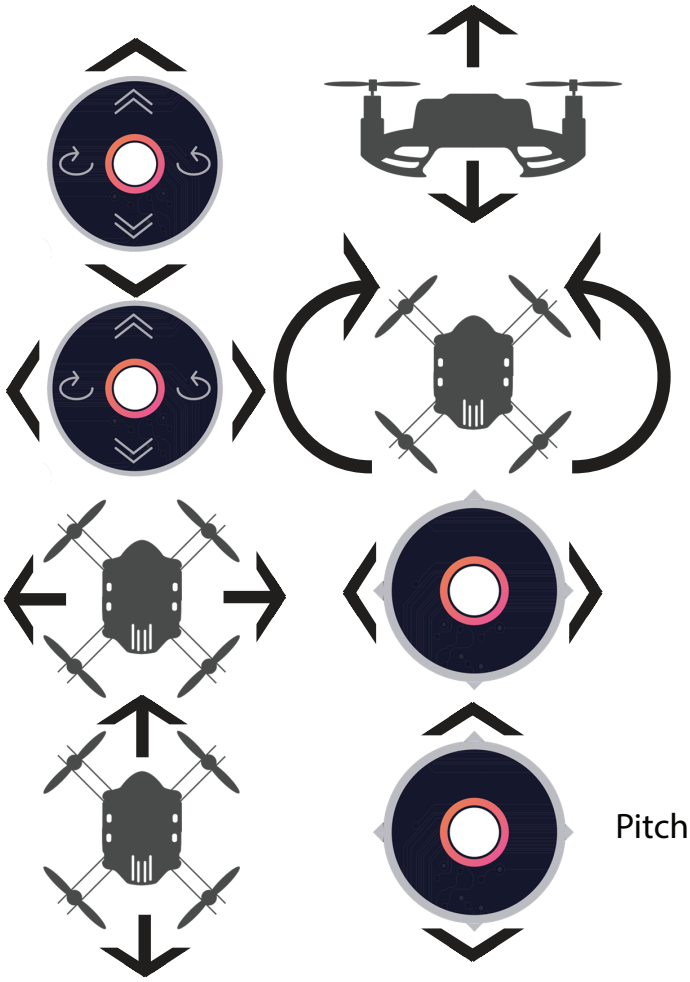
TIP: It's a good practice to perform Magnetometer calibration when:
a. Your are flying in a new location
b. Replacing the motors

CAUTION

Without proper magnetometer calibration, the yaw performance of the drone is severely affected.

Step 6 : Understanding controls

It's very important to understanding the Controls before you start flying. Please go through the following:

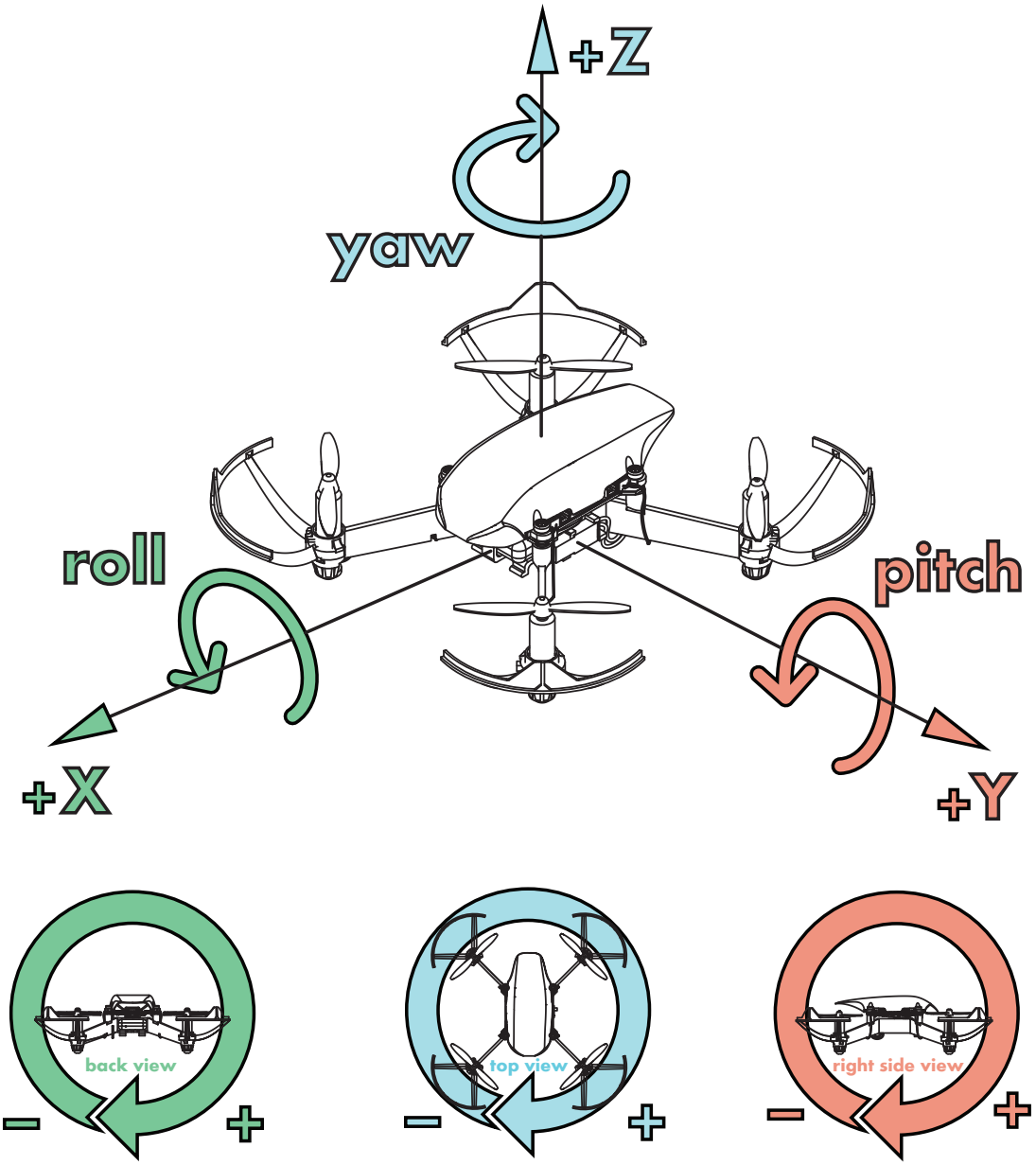


Altitude Up - Down

Yaw Left - Right

Roll Left - Right

Pitch Forward - Backward



Alternatively, you can also go through a video tutorial in your App :

Menu > Help > Pluto: Flying Instructions.

NOTE: If you are a beginner in flying drone, we recommend you to switch to “Tilt mode”. Go to Menu > Control Settings > Tilt mode

Step 7: Arming the Drone

The ARM switch controls power to the motors. Its can be thought of as a safety switch. If during anypoint you want to shut the motors, you can use the ARM switch to do so.

Note: In case, the Arm button has not been activated, go back and recalibrate. A few steps could have been missed during calibration

Disarming the PlutoX will land it. You can disarm by clicking on the arm button again.

Step 8: Fly it!

A. Click the ARM button.

B. Make sure you have a lot of free space.

C. Click on the Take-off button. PlutoX should take off to a height of about 3 feet.

D. Try to control only the roll and pitch of the drone. This significantly makes the flying task easy. Your first task is to hover at a point.

E. To land your drone, press the Land button.

Note: If you are new to drones, you will crash number of times before you learn how to fly. You don’t need to worry about the crash as the drone is crash resistant.

Assembly/Disassembly

PlutoX is a DIY drone. It can be disassembled and assembled easily. Please follow these instructions for assembly / disassembly.

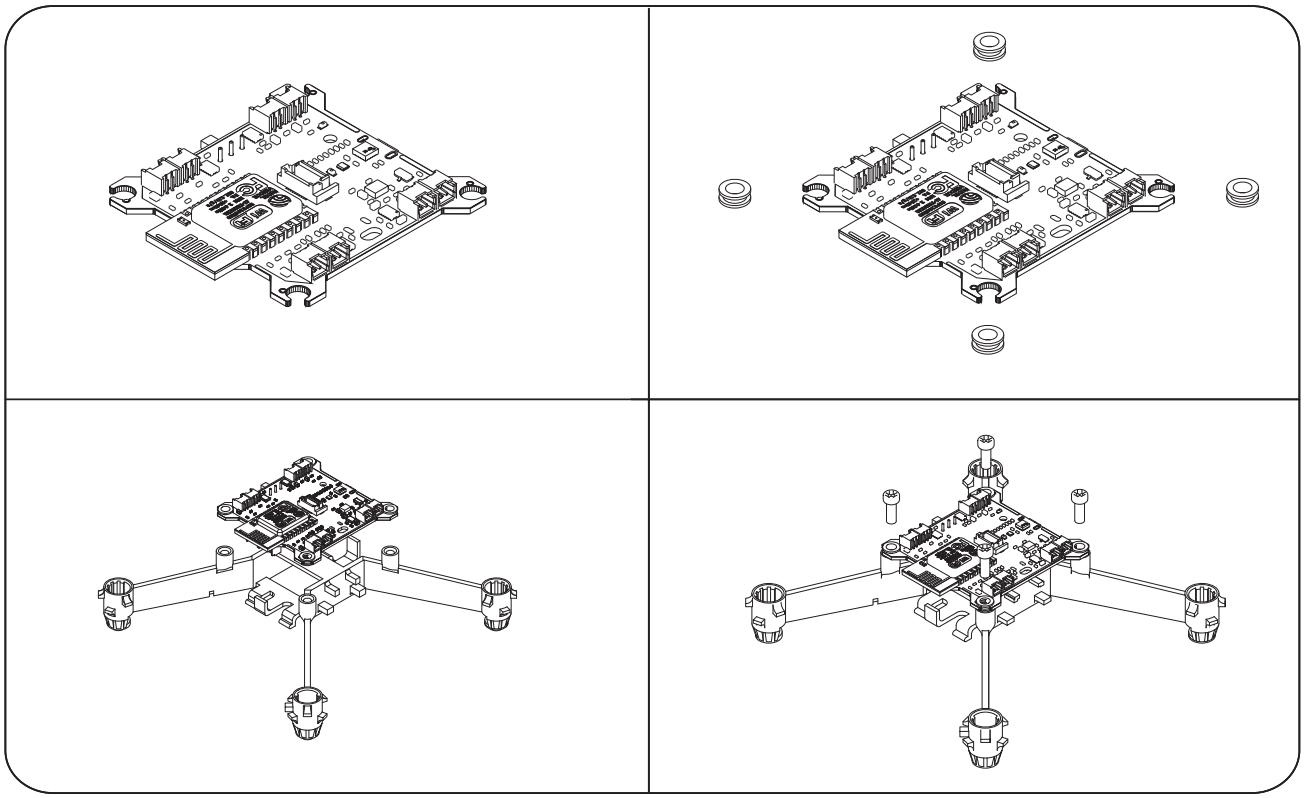
A. Flight Controller

1. Take the PrimusX flight controller. Identify the front of the board. Using the figure below.

2. Insert rubber dampers on four corners of the board.

3. Place the PrimusX board on the frame. Please ensure that the front arrow on the board matches arrow on the frame.

4. Insert the plastic screws and fasten the flight controller. Please ensure that the screws are not squeezing the dampers.



CAUTION

If the dampers are not used / improperly mounted, this will result in a poor performance of the drone..

B. Motor

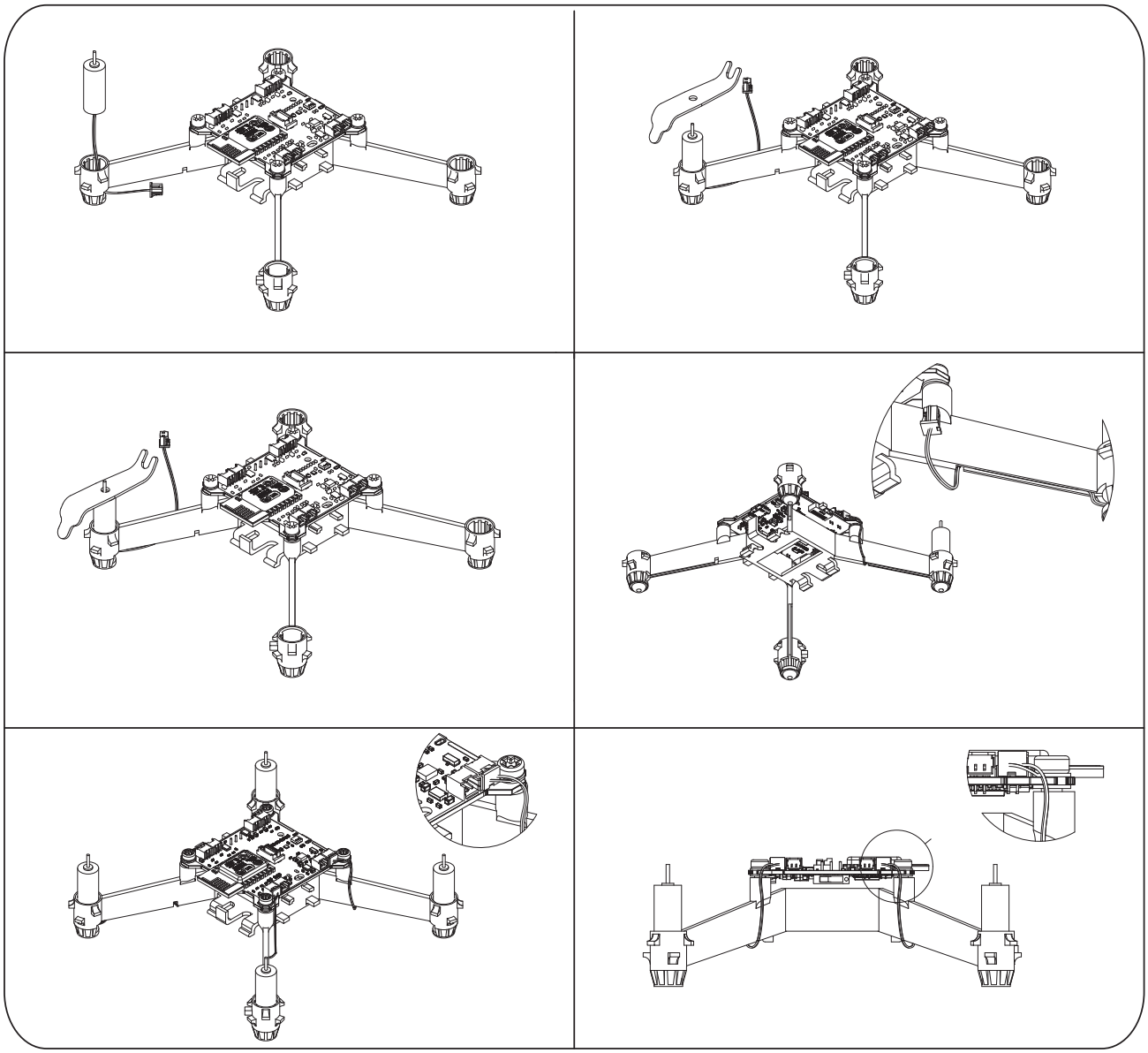
1. Insert the motor connector thought the end of the motor mount.

2. Place the motor in the motor mount.

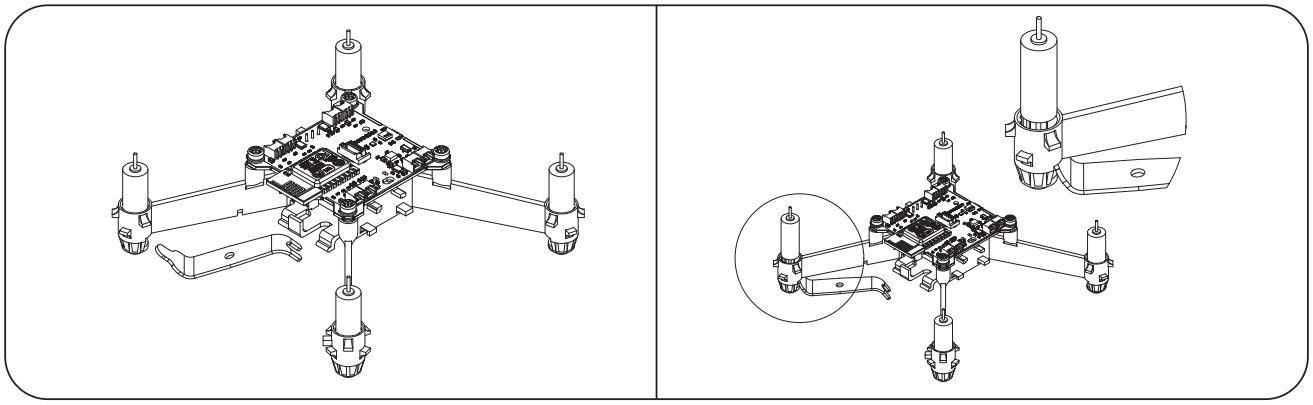
3. Using proptool push the motors inside.

4. Harness the motor wires on the bottom side of the motor arm.

5. Connect the motor connector to the correct port (M5 / M6 / M7 / M8).



6. To remove the motors from the frame use the proptool to provide the right leverage.



C. Canopy

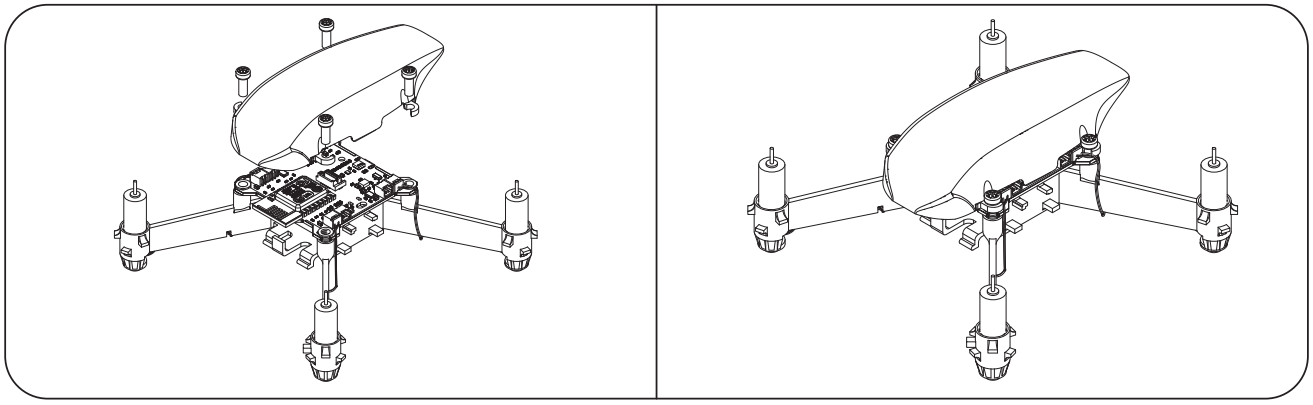
1. To Assemble the canopy, loosen the four flight controller screws.

2. The canopy has four mounts which go between the screw and the damper

.

3. By flexing the canopy, wiggle in the canopy between the screws and dampers.

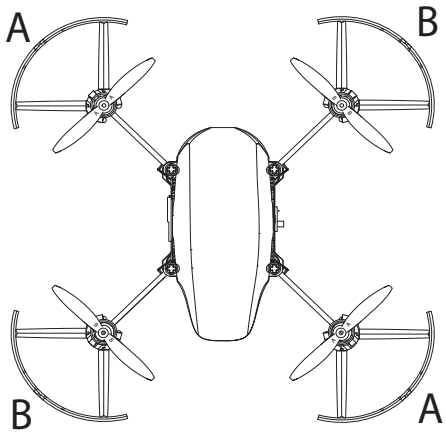
4. Tighten the screws if required.



D. Propellers and Prop

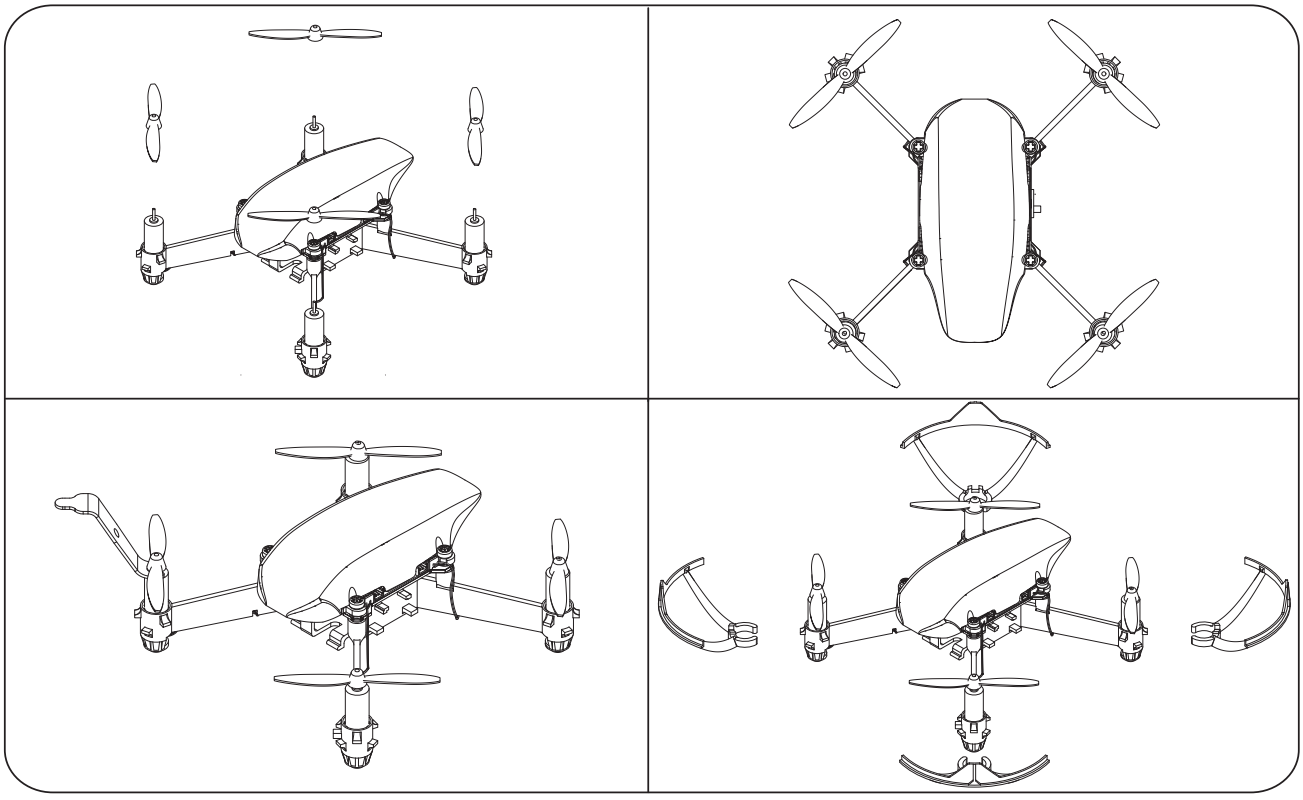
1. There are 2 sets of propellers labelled A & B. Please find the markings near the prop hub.

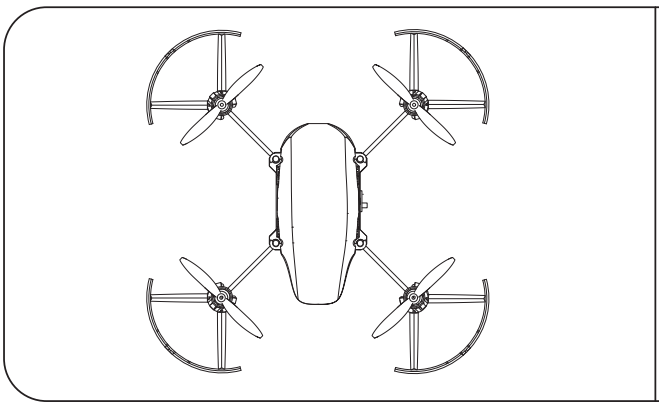
2. Place the propellers according to figure below

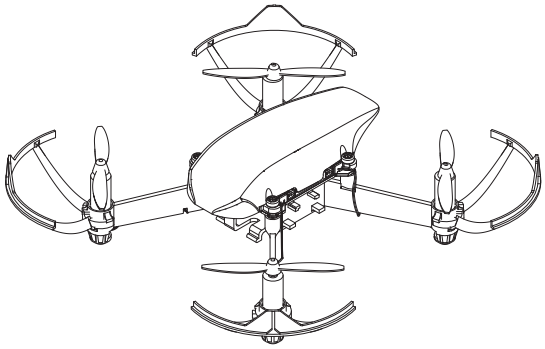


3. If you need to take out the propellers use the proptool for proper leverage.

4. Slide in the propguards are shown below.







CAUTION

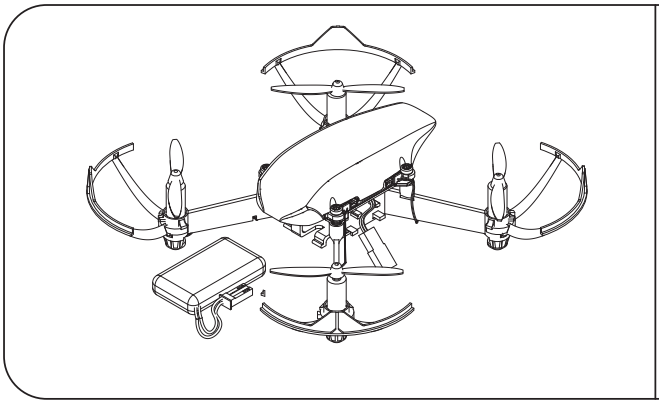
If the propellers are not placed propellery as per the A & B configuration, the drone will not take-off.

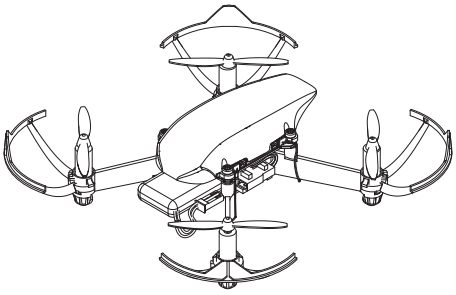
E. Battery

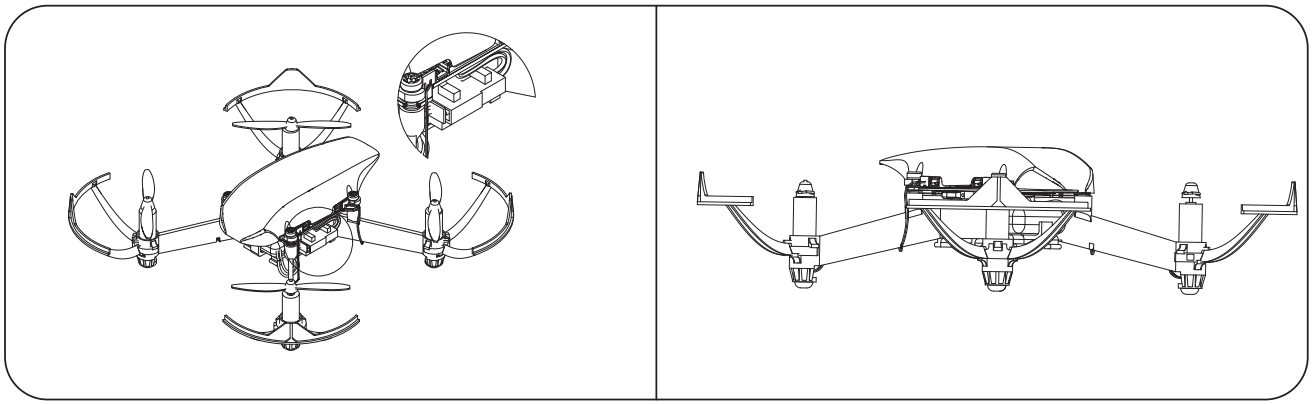
1. Insert the battery from the front of the drone as shown in the figure.

2. Carefully route the battery connector and connect to the board connector.

3. Use the connector holder to secure the connector to the frame.







F. Camera

PlutoX comes with a modular camera. This camera can also be accessed on a desktop for image processing(under development). Please visit developers.dronaaviation.com for more updates.

To use the camera do the following:

1. Assemble the camera on the bottom side of the drone. Please refer to 'Assembly / Disassembly' section for more details.

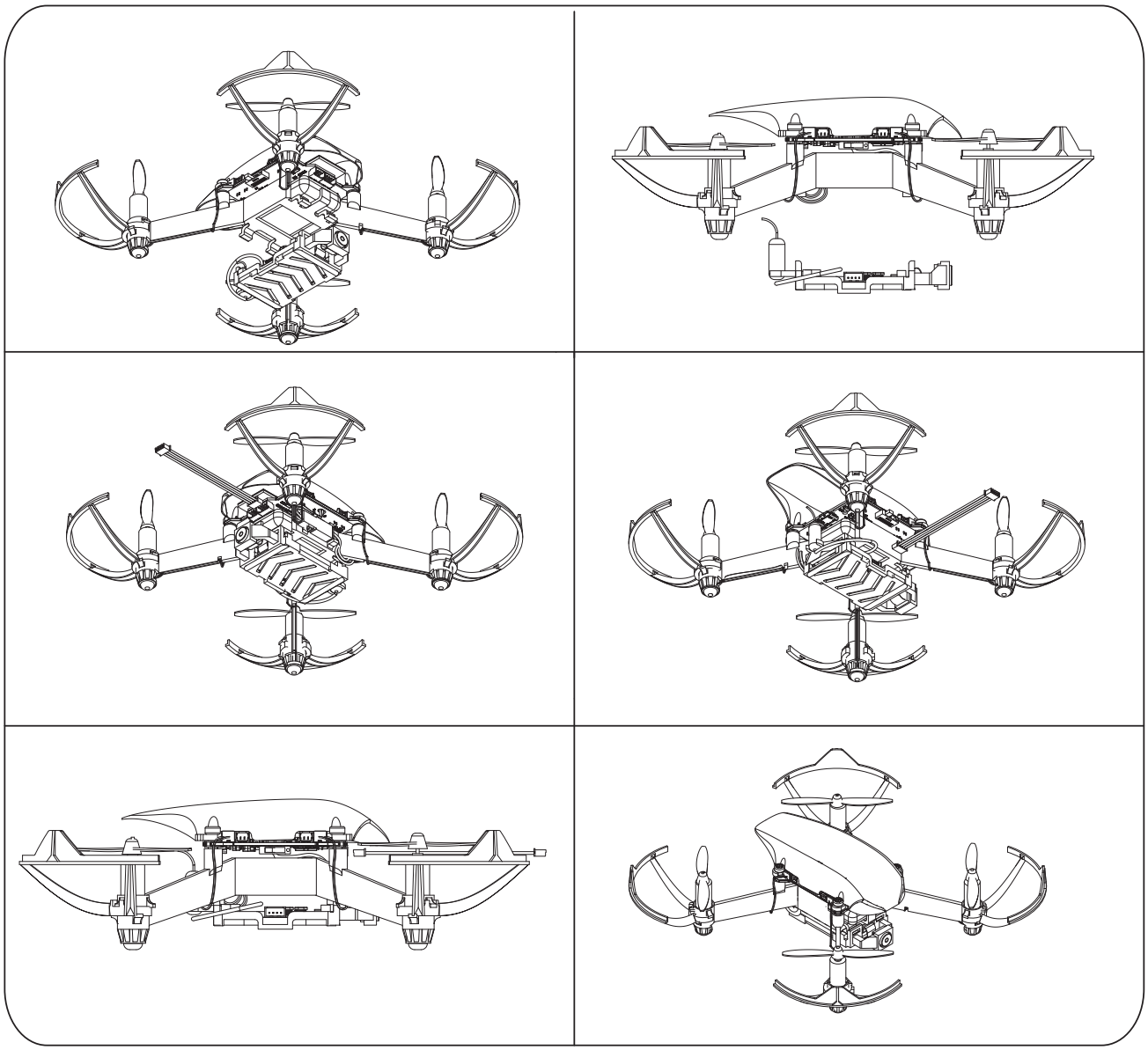
2. Make sure that the camera cable is attached to the flight controller.

3. Turn on the drone.

4. Find wifi named PlutoX_Cam_xxx.

5. Connect to this wifi.

6. Using Pluto Controller app press the connect button to connect with the camera wifi. You should see a live image from the camera immediately.



CAUTION

1. If you see two Wifi from the drone, the drone will not takeoff. Make sure thatthe camera cable is secure and restart the drone.

2. If you are not able to takeoff or receive any data from the drone, make sure that the camera cable is not damaged.

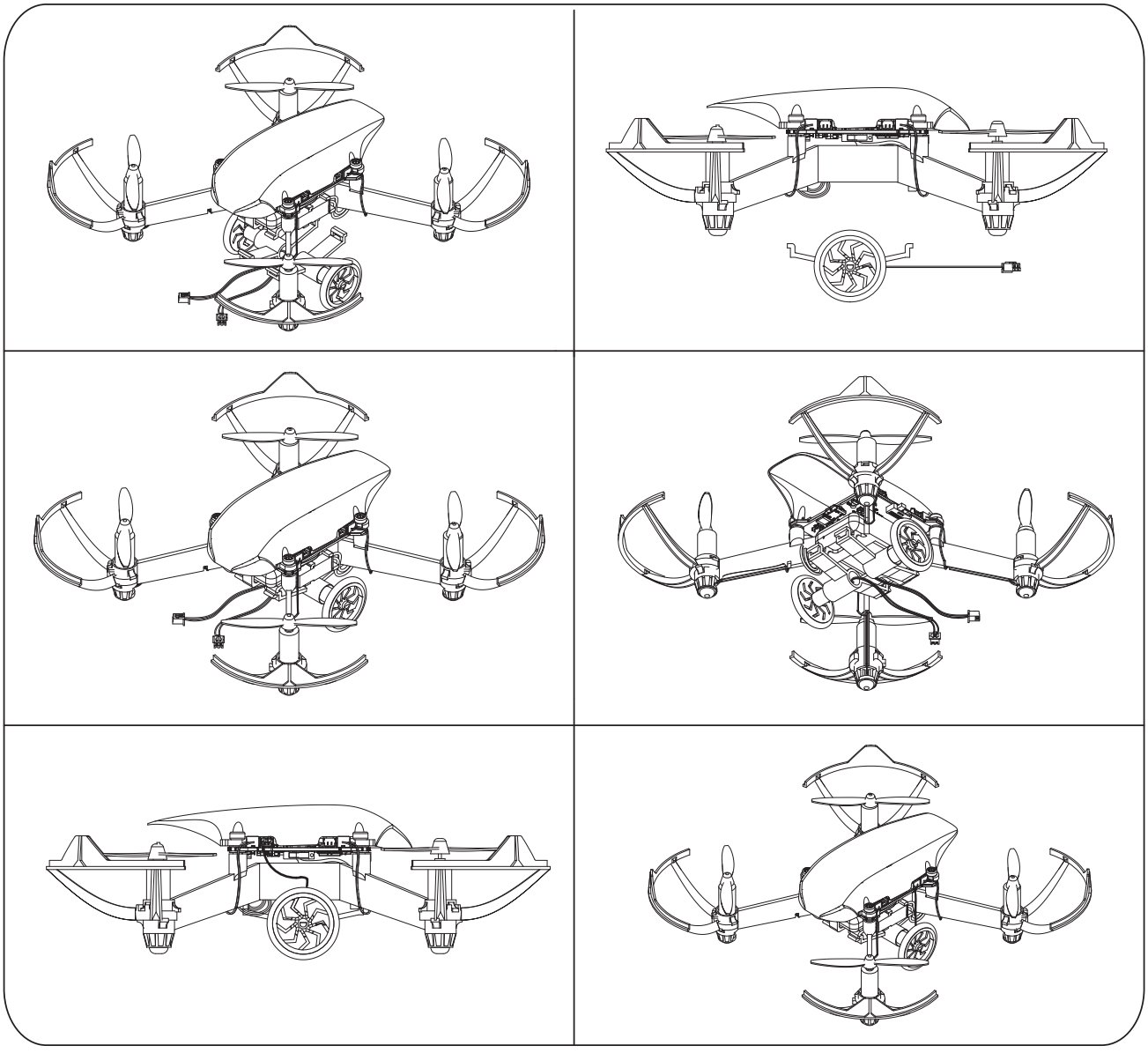
G. Hybrid Wheels

1. The set of 2 hybrid wheels provided have to be attached in the hooks given below the frame as shown in the figure.

2. Attach the wheels on vertical hooks such that the wheels face outwards.

3. Bring out the hybrid motor connectors and connect it to the slots labelled M2 and M3.

Note: Please remove Wifi Camera before integrating the hybrid wheels.



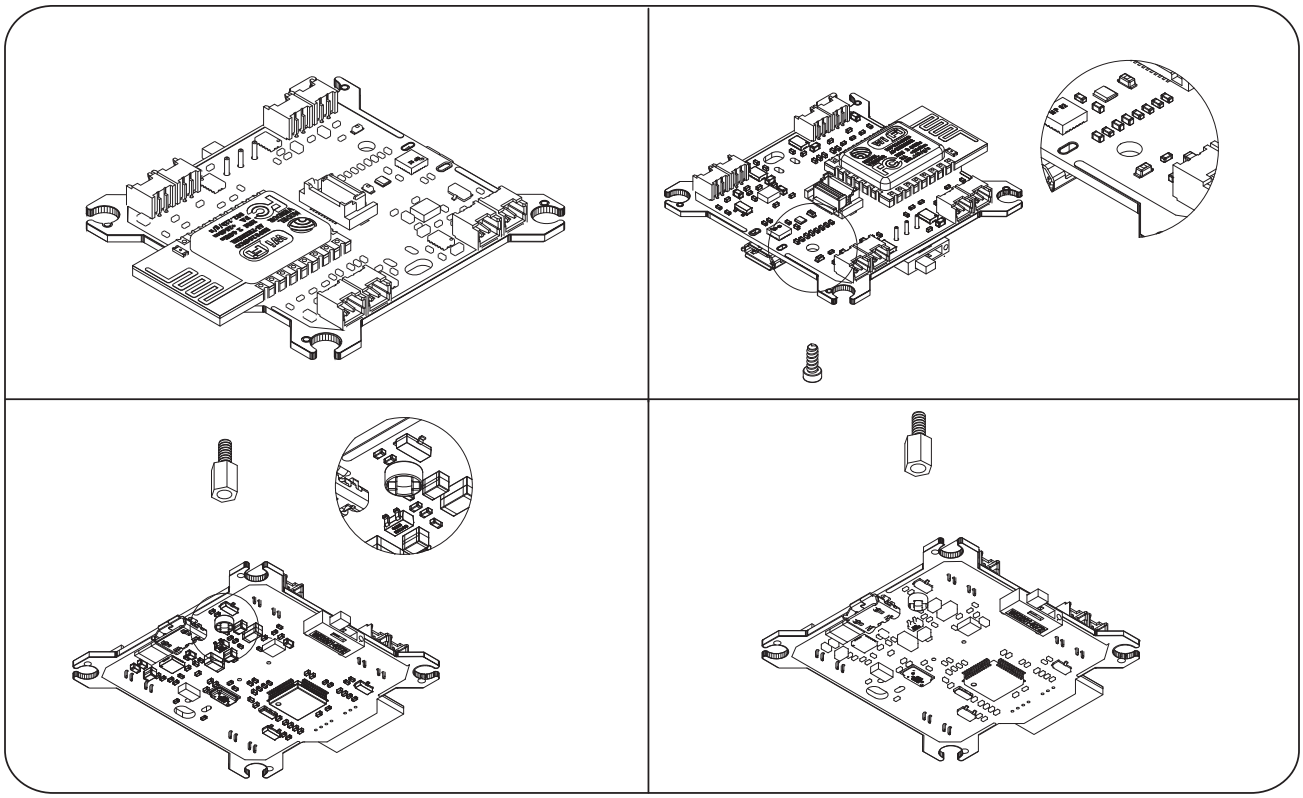
H. X- Breakout Assembly

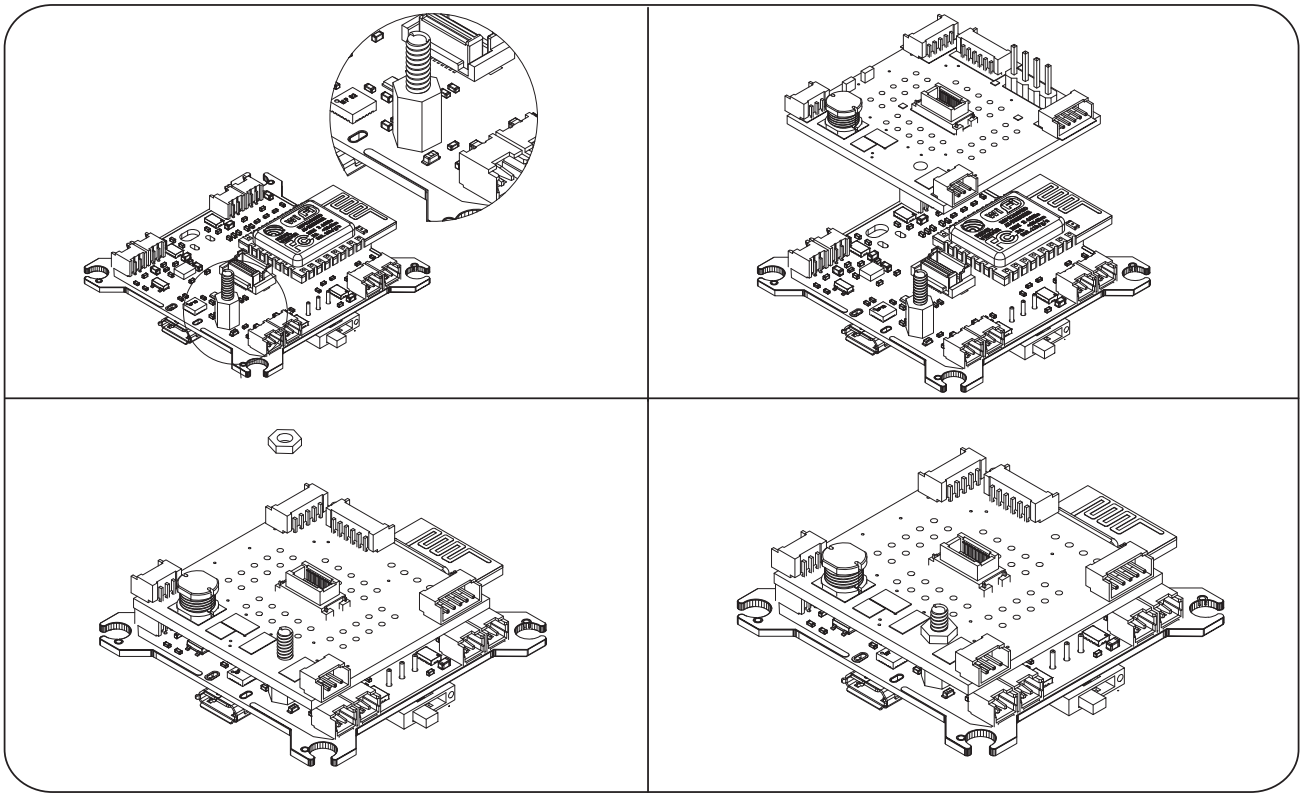
1. Insert the M2 nylon screw from under the board as shown in the diagram.

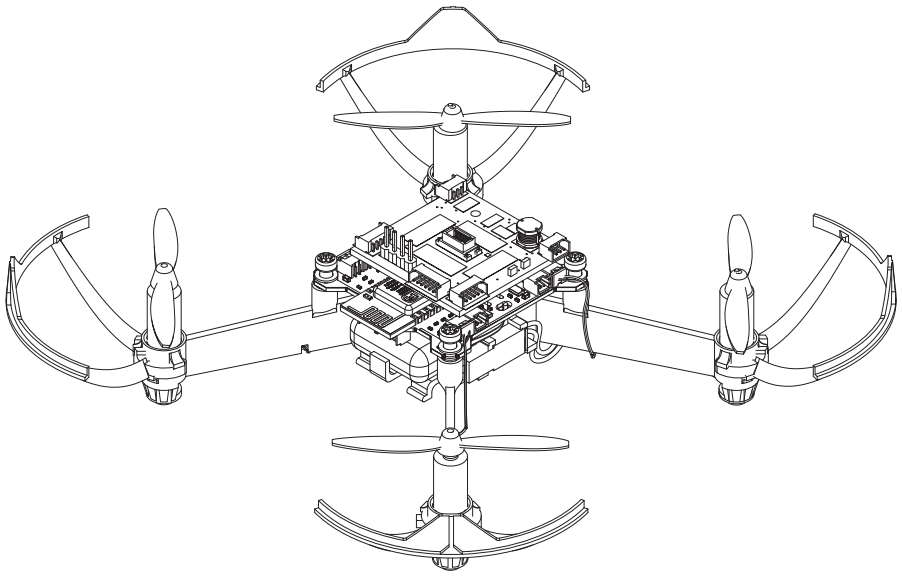
2. Place the M2 nylon Hexspacer above the nylon screw as shown the diagram.

3. Place the X-Basic above the PrimusX board such that the hole on X-Breakout aligns with the Hexspacer.

4. Tighten the nut on to the Hexspacer so that the X-Breakout properly fits onto the PrimusX board.







I. X- Ranging Assembly

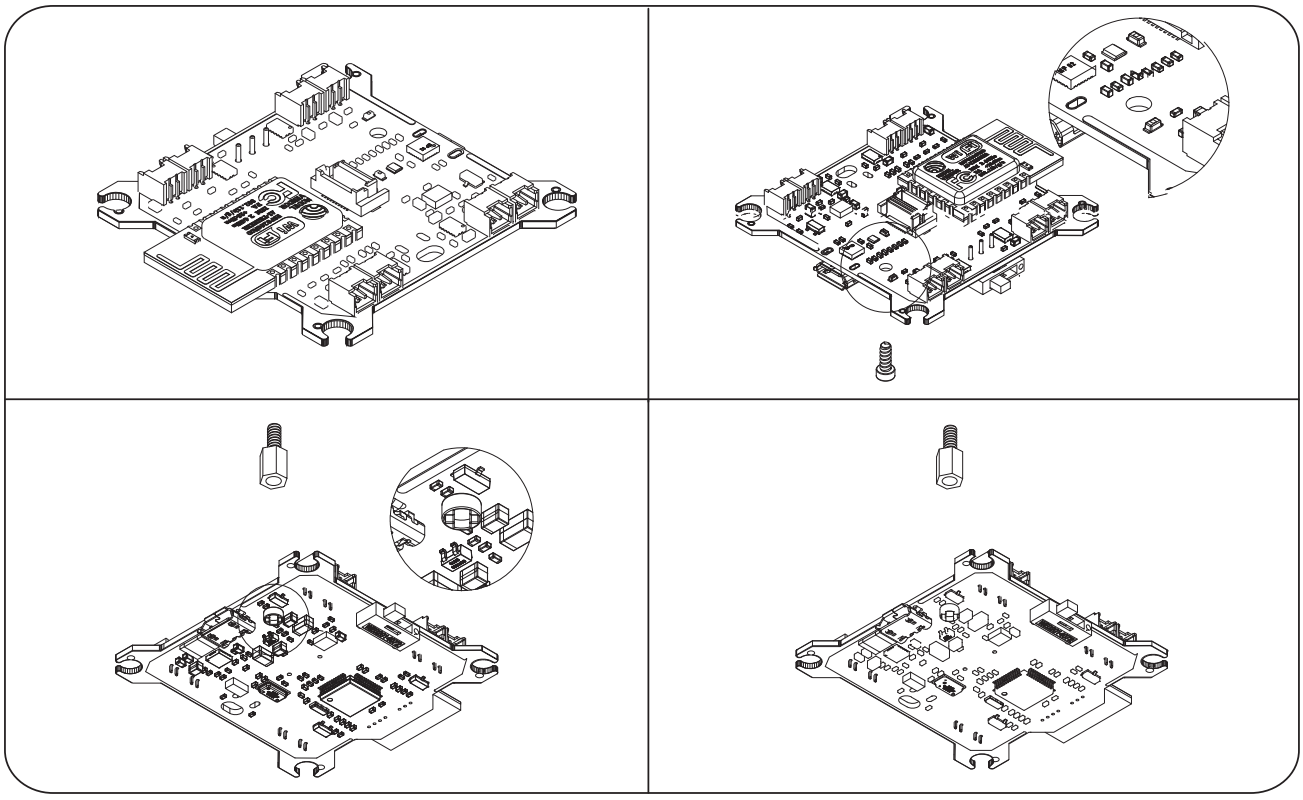
1. Insert the M2 nylon screw from under the board as shown in the diagram

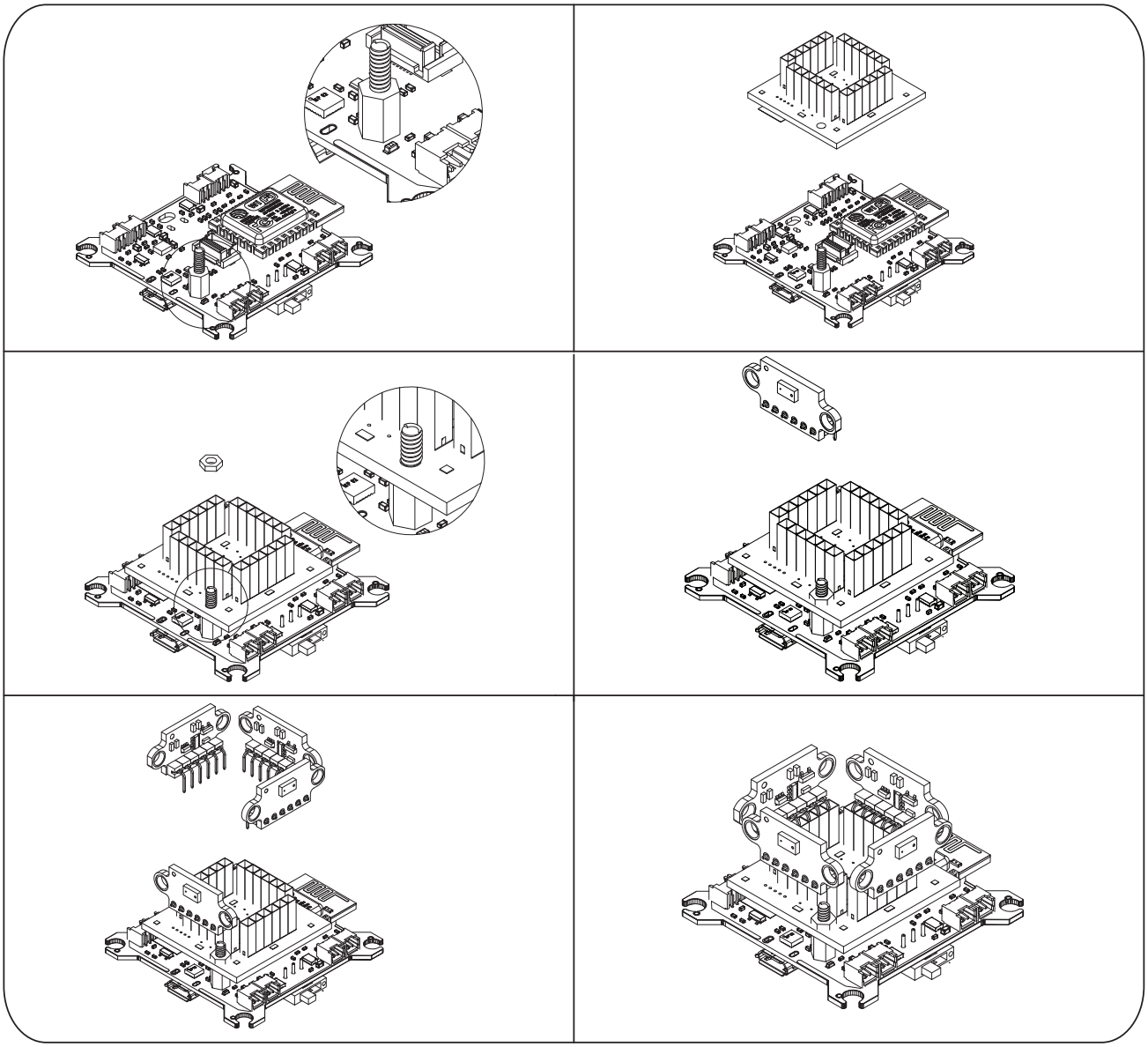
2. Place the M2 nylon Hexspacer above the nylon screw as shown the diagram.

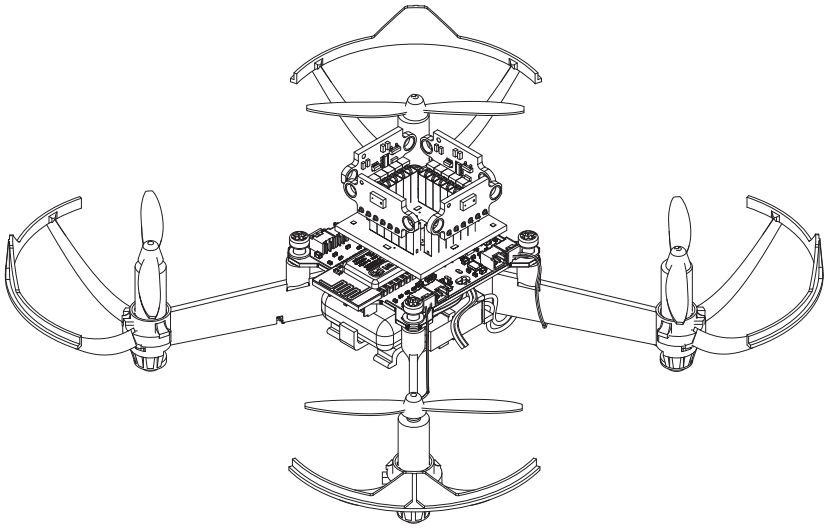
3. Place the X-Ranging above the PrimusX board such that the hole on X-Ranging aligns with the Hexspacer.

4. Tighten the nut on to the Hexspacer so that the X-Breakout properly fits onto the PrimusX board.

5.Place the VL53LOX sensor in any of the slots provided on X-Ranging board.







Battery charge

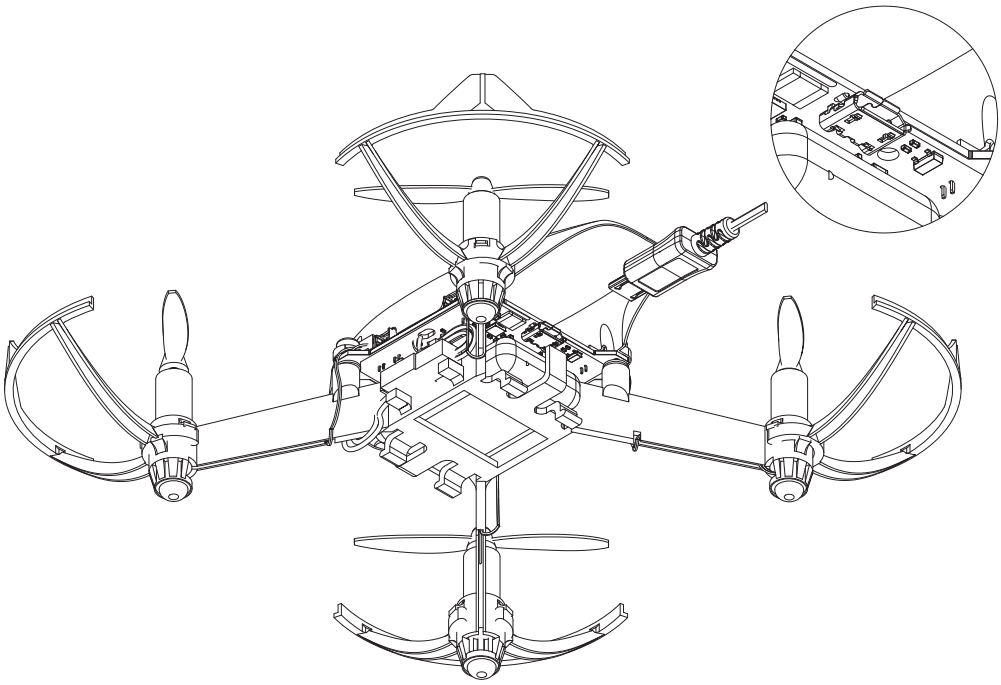
PlutoX provides an on board battery charging feature. PlutoX is equipped with a Micro-B USB port as shown in the figure. To charge the battery,

1. Switch off the PlutoX

2. Connect a Micro-USB cable to the USB port.

3. Battery charging is indicated by a Red LED labeled D1.

4. When the battery is completely charged, the Red LED stops glowing. It takes around 50 minutes to completely charge the battery.



- **Never discharge Li Po cells to below 3V under load.**
- **Never cover warning labels with hook and loop strips.**
- **Never charge batteries in extremely hot or cold places or place in direct sunlight.**
- **Never leave charging batteries unattended.**
- **Never charge batteries outside**
- **Never charge damaged batteries.**
- **Never allow minors to charge battery**

Trim

Trim is a feature used to ensure very low drifts in your PlutoX. You might have observed that, when you take-off using the take-off button, the drone drifts in some direction. TRIM is used to ensure very low drifts in the XY-Plane.

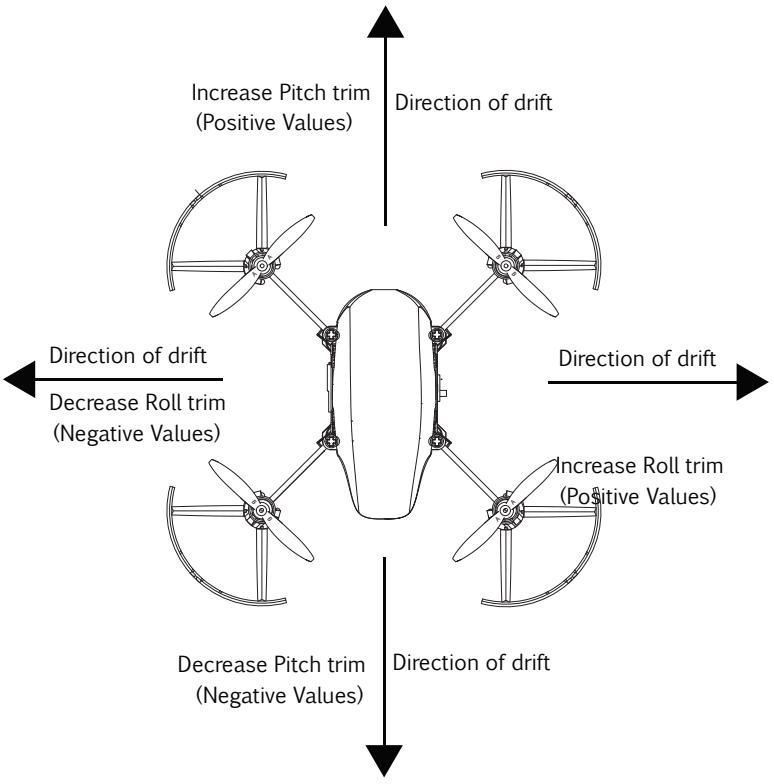
Please perform the following steps:

1. Make sure that your have performed acc calibration before starting Trim.

2. Identify which direction is the drone naturally drifting towards.

3. Using Pluto Controller navigate to:
Menu > Drona Settings > Trim

4. Trim the Drone in units of 5 to see considerable change. The units of trim areas shown in the figure below.



Control Settings

Flight Modes

PlutoX has various flight modes. Changing the flight mode will change the way you control your drone.

Althold / Throttle mode
This controls how you controls the drone in the Z-axis.

Throttle mode: When you choose this mode, you control the amount of power supplied to the motors. This essentially controls the acceleration of the drone in the Z-axis. This mode can be hard for a beginner as you would constantly need to provide input to maintain altitude.

Althold mode: When you choose this mode, you control the velocity of the drone in the Z-axis. This is much easier to control. When the control stick is in the center, the drone tries to maintain its altitude.

Headfree mode: This mode affects the way you control roll and pitch of the drone. When this mode is off, the pilot needs to constantly monitor, the yaw of the drone. If the pilot loses orientation of the drone, it can be quite challenging to control the
drone.
When headfree mode is on, the pilot doesn't need to worry about the yaw angle ofthe drone, the drone manupalites the roll and pitch inputs accounting for changed yaw. This mode is highly recommended for beginners

Control Modes

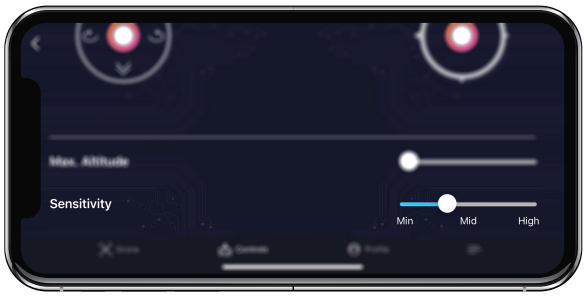
Joystick/Tilt mode: This customises how you control the roll/pitch of the drone.

Joystick mode: In this mode, the roll/pitch of the drone is controlled by on screen joystick. As touch screen lacks tactile feedback, it required some getting used to.

Tilt mode: In this mode, the roll/pitch of the drone is controlled by the tilt of your phone. This mode is much easier to fly for beginners.

Sensitivity

Sensitivity refers to the level of response the drone gives to the controller inputs. For higher sensitivity, even a small input would reflect a huge difference and for lower sensitivity, large inputs would be required for noticeable change. Adjust the sensitivity according to the Pilots style of flying.



Note: We recommend the beginners to keep the sensitivity levels to Low.

Max Altitude

This setting helps you limit the drones maximum height. By default your drone does not limit the height.

CAUTION

1. This feature is still in beta, please use with care.

2. This feature only works in Althold mode

External Controller

To use an external controller, connect controller to the phone using Bluetooth/USB. To change the external controller settings, go to Menu > Controller Settings > Gamepad icon

Steps 1 : Connect the controller to your phone.

If you are using a USB based controller, you will need an OTG Cable.

Step 2 : Configure your controller.

To change the external controller settings, go to

Menu > Controller Settings > “Gamepad Icon”

If your joystick controller is supported by your phone, the icon turns green instead of red.

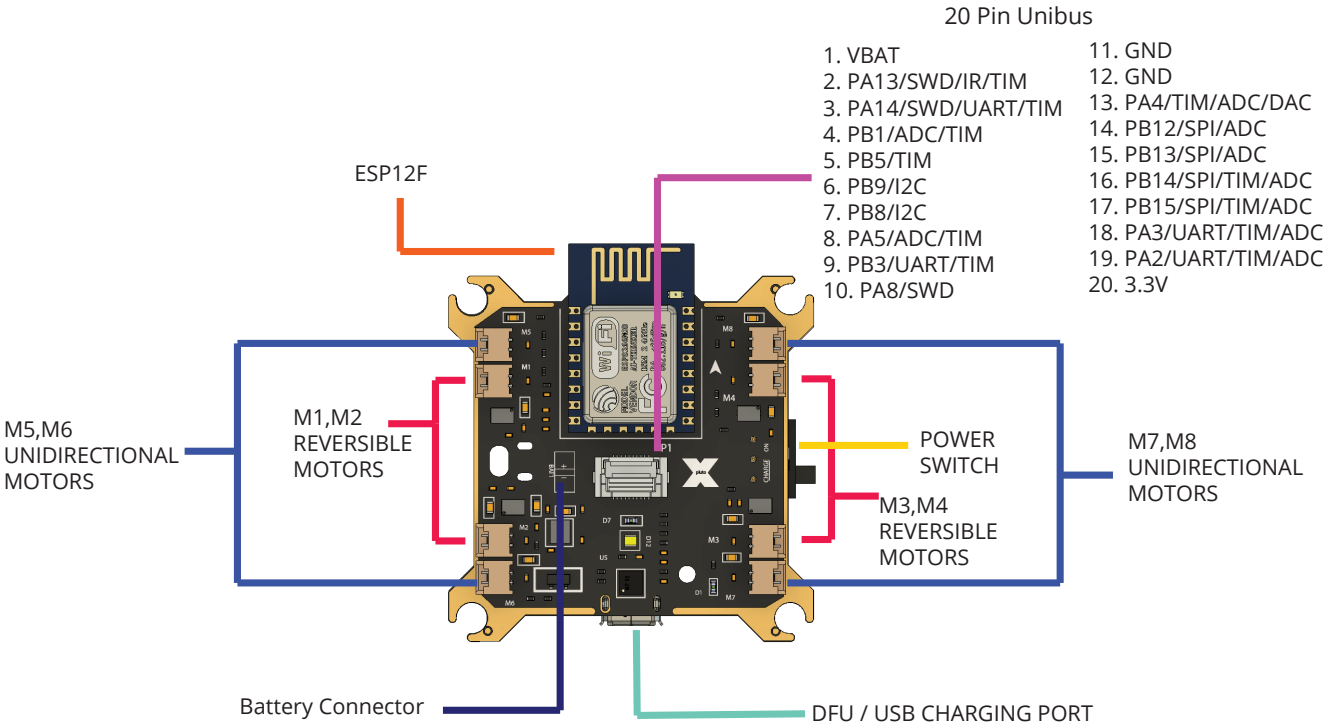
Step 3 : Assign proper channel.

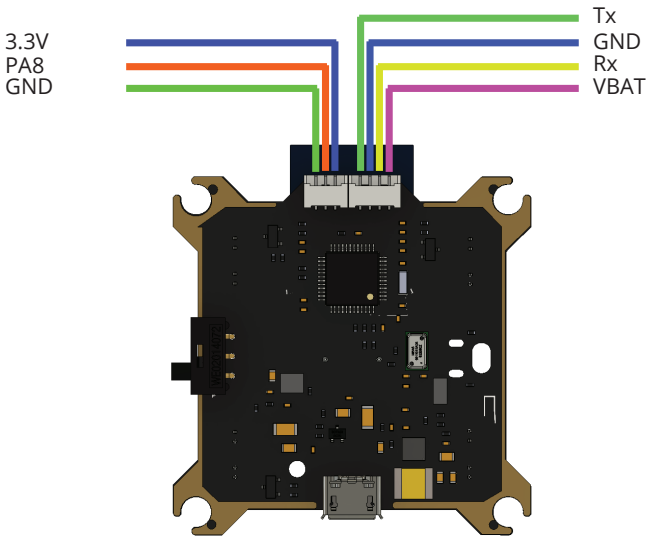
Move the sticks and buttons of your controller to identify and assign the right controls..

Note: : Depending on your phone there are different controllers supported. We have tested to find that microsoft game controllers are generally detected on allandroid smartphones.

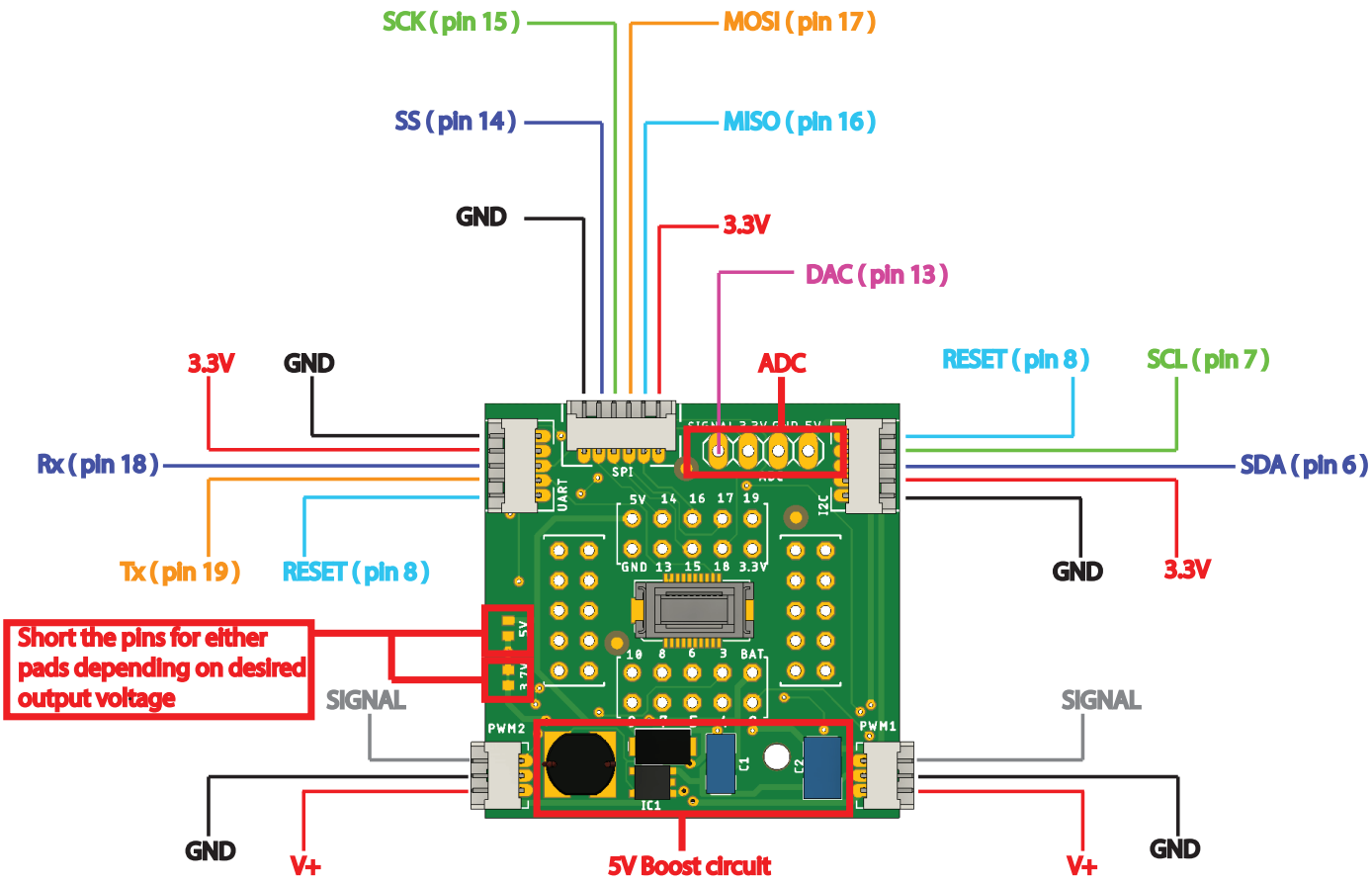
Flight Controller Information

PrimusX





X-Breakout



Updating firmware

To update firmware on PlutoX, follow these steps:

Step 1 : Go to Menu > Update firmware

Step 2 : Tap on 'Get Latest Firmware'

Step 3 : Tap on 'Magis-X'. This firmware is a stable firmware for PlutoX.

Step 4 : In case you have downloaded the firmware from internet, you can also load the firmware using 'Browse' button.

Step 5 : Make sure that you are connected to you PlutoX and Tap on 'Flash' button. This will start flashing your PlutoX.

CAUTION

1. Please do not flash 'Magis-V3R' on PlutoX. This will freeze PlutoX microcontroller. If it does happen by mistake, just flash the current version 'Magis-X' and flash you drone.

2. Do not turn off PlutoX while Flashing

Developer options

PlutoX is meant for tinkering. When you want to program your drone, you can use the Cygnus IDE to write user code. Along with Cygnus IDE, you will have to enable developer mode on you app. For more information on programming your drone, use PlutoX Project Book.

Please follow the steps to enable developer mode on you app:

Step 1 : Go to Menu > Pilot Profile

Step 2 : Tap on the pencil option to edit your profile.

Step 3 : Tap on 'I am a developer'

Step 4 : Go to the home screen of Pluto Controller app. You should see '</>' button. You can tap on this button to enable the user code.

Step 5 : Tap on '</>' button to disable user code.

Tip: In android phone, you can also enable the user code by pressing the volume up button instead of pressing </> button on the screen. You can disable the user code by pressing volume down

Troubleshooting

Led status

For reference: R - Red LED, G - Green LED, B - Blue LED

LED Status	Indication	Action required
G On	Connected with App. Ready to ARM	-
B On	Drone is Armed.	-
R On	Low battery	Charge the battery
Cyclic R, G, B	Waiting for the app to connect.	Connect using App
G Toggle	Pluto is not of a flat surface	Keep pluto on flat surface.
B Toggle	Signal loss	Reconnect to pluto
R Toggle	Low battery In-flight	Land & Charge the battery
Pink Toggle	Gyro not calibrated	Keep Pluto undisturbed / Perform Acc calibration
Yellow Toggle	Mag not calibrated	Perform Mag calibration
R long toggle & short toggle	MPU error	Contact support
G long toggle & short toggle	Baro error	Contact support
B long toggle & short toggle	Crystal error	Contact support

FAQ

Q: Some motors are not rotating.
A: This could happen due to multiple reasons. Please check the following:
Make sure that motor is inserted in the default motor ports: M5 / M6 / M7 / M8.
Check if the motor cable is damaged. If damaged, replace the motor.
Check if propeller is able to freely rotate on the motor shaft. If not, use the proptool to create some gap between motor and hub of propeller.

Q: Drone not taking off
A: Please check the following:
Ensure that your battery is fully charged.
Propellers are mounted as recommended. Check “assembly / disassembly” section for more information.
Check if you are connected to your Pluto’s wifi.
After you are ‘connect’ to PlutoX using the app, ensure that you are getting a solid green led. If not, please use the “LED status” section above to correct for any errors.

Q: Drone keeps drifting
A: The drone controls angles and not velocities. Some drift can be expected. Inorder to reduce this drift you can try the following:
Perform Acceleration calibration on a flat surface.
Please follow the “Trim” section to reduce drift as low as possible.

Q: Altitude Hold performs erratically.
A: To maintain altitude, the drone uses a mems barometer. You can expect the altitude to vary +/- 50cm. This is normal. If the drone is very erratically in Z-axis, one possible cause is excessive vibration. Please ensure the following:
Replace propeller if the propeller is damaged. Very little damage can also cause excessive vibrations
Make sure that the PrimusX board is not in contact with plastic part but only the dampers.

Q: I can’t see the wifi Hotspot
A: Please try restarting the drone.

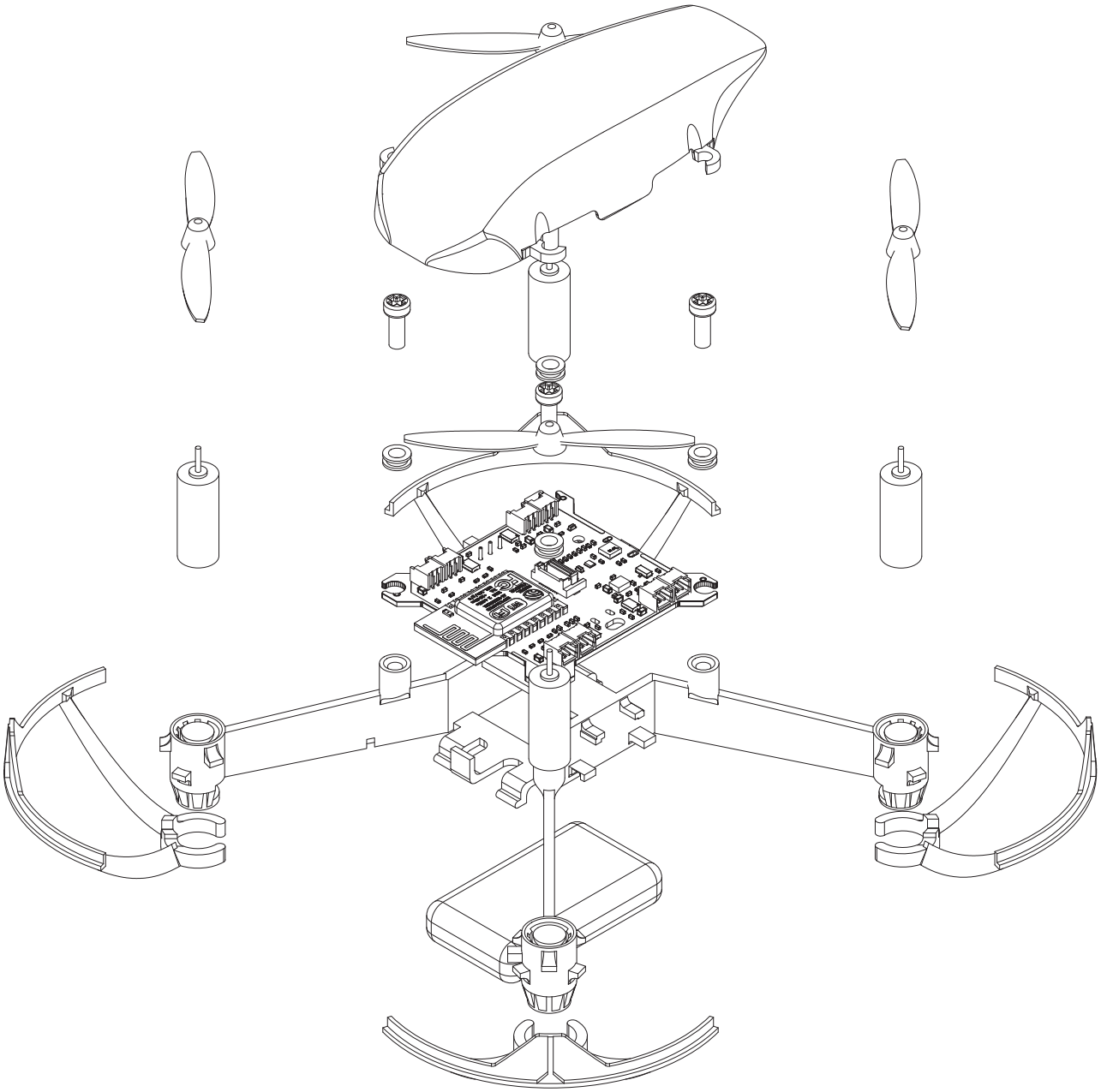
Q: Drone keeps rotating / yawing.
A: Make sure that the drone’s magnetic calibration is performed properly.

Failsafe Information

PlutoX has some failsafe options. This section lists the various options & behaviors of the drone in failsafe.

Failsafe	Condition	LED	Behavior
Low Battery (Not armed)	Batt voltage < 3.4V	Solid red LED	Does not let you ARM the drone
Low Battery (In-flight)	Batt voltage < 3.0V	Blinking red LED	-
Loss of range	No signal for 2s	Blinking blue LED	Land drone at the current position
Crash	Acceleration > 2g or Roll/Pitch > 50 degrees	Blinking pink LED	DisArms the drone

Spares



The following components are available as spares:

Canopy

Frame

Prop Guard set

Propellers set

Prop Tool

Motor

Battery

Dampers set

Screws M3 Nylon set

Screws M2 Nylon set

Spacers M2 Hex set

Nut M2 Nylon set

Camera

X-Hybrid set

X-Ranging

Ranging Sensors

X-Basic

4 Pin Connector Cable

PlutoX Flight Controller

Landing Pads set

3 Pin Connector Cable

Support

For questions and technical help:

Website : https://www.dronaaviation.com/support

Email: support@dronaaviation.com

GitHub: https://github.com/DronaAviation

Forum: https://www.dronaaviation.com/forum

Specifications

Drone Specifications

Height	50 mm
Frame Size	160 mm
Clock	72 MHz
Wireless communication	Wi-Fi Interface
Propulsion	Brushed
Propeller	Bi-Blade 55 mm
Weight with battery	60 g
Max Range	60 m

Camera Specifications

Photo Format	JPEG
Picture resolution	72ppi
Video resolution	1280p x 720p
Video Standard	High Definition
Camera Sensor	CMOS
Storage	Phone Internal Storage/SD Card Storage

Battery Specifications

Manufacturer	Tattu
Rated Capacity	600 mAH
Rating	25 C
Type	Lithium polymer battery

Other Specifications

Processor	STM32F303: 72Mhz
Total drives	4 MOSFET drives + 4 H-Bridge drives
Sensor suite	10 DOF
Wifi interface	ESP12F
Flight time	10 mins
Range	200 feet
Unibus 20 pins: 16 pins GPIO	1. Analog Pins: 9 2. Timer channels: 11 3. UART: 1 4. SPI: 1 5. I2C: 1 6. DAC channels: 2
4 Power pins	1. +3.3V Line, 500mA of current sourcing 2. 2 x GND 3. VBat
Gyroscope	MPU